

Amendments to the Drawings:

The attached sheet of drawings includes changes to Figure 1A. This sheet, which includes Figures 1A and 1B, replaces the original sheet including Figures 1A and 1B.

Attachment: Replacement Sheet

REMARKS/ARGUMENTS

Claims 1-22 are currently pending in the present application, of which claim 1 is the sole independent claim. Claim 10 has been withdrawn from consideration. Claim 2 has been canceled without prejudice or disclaimer. Claims 1, 3-12, 15 and 21 have been amended by this Amendment. New claim 22 has been added by this Amendment.

Information Disclosure Statement

Applicants did not provide copies of non-patent literature (Algora) with the first IDS filed July 26, 2006 because the cited reference Algora should have been provided to the USPTO by WIPO with the International Search Report for this application. Nevertheless, for the Examiner's convenience, Applicants submit herewith a supplemental IDS providing a copy of the non-patent reference Algora that was identified as not considered by the Examiner. Applicants also note that page 1 of the second IDS filed July 26, 2006 listed corresponding US documents for each of the foreign language prior art documents. Applicants respectfully request that the Examiner consider these foreign language prior art documents (also re-listed in the supplemental IDS) as the corresponding US documents provide the requisite concise explanation of relevance.¹

Drawings

The drawings stand objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the reference character (17) in Fig. 1A, which is not mentioned in the description.

¹ With respect to DE 10303977 and DE 10303978, US 2005/0239270 was cited as the corresponding US document in the IDS filed July 26, 2006. There is, however, more than one US document in this patent family, and US 2006/0246687 is cited as corresponding to DE 10303977 and US 2006/0180804 is cited as corresponding to DE 10303978 in the supplemental IDS filed concurrently herewith.

Applicants submit herewith a replacement sheet removing the reference character (17) from Fig. 1A. Withdrawal of the objection to the drawings is therefore requested.

Claim Rejections under 35 USC § 112

Claims 1-9 and 11-21 stand rejected under 35 USC § 112, second paragraph, as indefinite.

The Examiner asserts that the limitation “downstream” in claim 1 is unclear because the direction of the “stream” is not specified. Applicants’ claim 1 recites “an active layer, which emits electromagnetic radiation in a main radiation direction” and “a current expansion layer, which is disposed downstream of the active layer in the main radiation direction”. It is clear from the language of claim 1 that the direction of the stream is the “main radiation direction” and, therefore, that “downstream of the active layer” is downstream in the main radiation direction.

The Examiner asserts that there is insufficient antecedent basis for the limitation “the radiation” in claim 1. Claim 1 has been amended to provide proper antecedent basis for this limitation.

The Examiner asserts that there is insufficient antecedent basis for the limitation “the transverse conductivity” in claim 1. Claim 1 has been amended to provide proper antecedent basis for this limitation.

The Examiner asserts that it is unclear whether the limitation “a two-dimensional electron and hole gas” in claim 2 is the same as the limitation “a two-dimensional electron gas or hole gas” recited in claim 1. Claim 2 has been canceled and its limitations incorporated into claim 1. The limitations of claim 2 incorporated into claim 1 have been amended to have proper antecedent basis.

The Examiner asserts that there is insufficient antecedent basis for the limitation “the number of layers” in claim 4. Claim 4 has been amended to provide proper antecedent basis for this limitation.

The Examiner asserts that there is insufficient antecedent basis for the limitation “the dopant concentration” in claim 8. Claim 8 has been amended to provide proper antecedent basis for this limitation.

The Examiner asserts that there is insufficient antecedent basis for the limitation “the region” in claim 8. Claim 8 has been amended to provide proper antecedent basis for this limitation.

The Examiner asserts that there is insufficient antecedent basis for the limitation “the layer” in claim 8. Claim 8 has been amended to provide proper antecedent basis for this limitation.

The Examiner asserts that there is insufficient antecedent basis for the limitation “the emitted radiation” in claim 21. Claim 21 has been amended to provide proper antecedent basis for this limitation.

Claim Rejections under 35 USC § 102 and 35 USC § 103

Claims 1-4, 6-8, 11, 15 and 17 stand rejected under 35 USC § 102(b) as anticipated by U.S. Pat. No. 6,541,797 (“Udagawa”). Claims 5, 9, 12-14 and 16 stand rejected under 35 USC § 103(a) as unpatentable over Udagawa. Claims 18-20 stand rejected under 35 USC § 103(a) as unpatentable over Udagawa in view of U.S. Pat. No. 5,744,828 (“Nozaki”). Claim 21 stands rejected under 35 USC § 103(a) as unpatentable over Udagawa in view of U.S. Pub. No. 2003/0111667 (“Schubert”).

Discussion of Disclosed Embodiments

The following descriptive details are based on the specification. They are provided only for the convenience of the Examiner as part of the discussion presented herein, and are not intended to argue limitations which are unclaimed.

Applicants' disclosed embodiments are directed to a thin-film LED. (See FIG. 1A of the published application showing a cross section of the line I-II from a plan view shown in FIG. 1B). The thin-film LED contains an epitaxial layer sequence 16 comprising an active layer 7. The active layer 7 emits electromagnetic radiation 19 in a main radiation direction 15. The electromagnetic radiation 19 emitted in the main radiation direction 15 by the active layer 7 is coupled out from the thin-film LED through a main area 14. (See paragraph 46 of the published application).

A first contact layer 11, 12, 13 is provided on the main area 14 of the thin-film LED. A current expansion layer 9 containing a first nitride compound semiconductor material, preferably GaN, is contained between the active layer 7 and the first contact layer 11, 12, 13. Embedded in the current expansion layer 9 made of the first nitride compound semiconductor material is at least one layer 10 made of a second nitride compound semiconductor material, preferably made of AlGaN. In other words, the current expansion layer 9 is a multilayer layer comprising for example two GaN partial layers 9a, 9b separated from one another by an embedded AlGaN layer 10. (See paragraph 48 of the published application). The transverse conductivity of the current expansion layer 9 is improved by the semiconductor layer 10 embedded in the current expansion layer 9. (See paragraph 49 of the published application).

Arguments

The art cited by the Examiner fails to teach or suggest “wherein at least one layer made of a second nitride compound semiconductor material having a larger electronic band gap than the first nitride compound semiconductor material is embedded in the current expansion layer to form a two-dimensional electron gas or hole gas in the current expansion layer”, as expressly recited by Applicants’ amended claim 1 because Udagawa does not disclose a current expansion layer including a layer having a larger electronic band gap embedded therein.

Udagawa relates to a light-emitting diode (LED). (See Fig. 14 of Udagawa). The Examiner (at pages 5-6 of the Office Action) asserts that Udagawa discloses a current expansion layer including a thin layer 107, a p-type layer 103 and a p-type top surface layer 112. However, Udagawa discloses at col. 23, line 30 that the thin layer 107 is an undoped high-resistance thin layer. The thin layer 107 of Udagawa therefore cannot be a current expansion layer because it is an undoped high resistance layer. That is, an undoped high resistance layer does not expand a current.

The P-type layer 103 and the p-type top surface layer 112 of Udagawa are made of different nitride compound semiconductor materials. In particular, the p-type layer 103 is made of Mg-doped $\text{Al}_{0.10}\text{Ga}_{0.90}\text{N}$ and the p-type top surface layer 112 is made of GaN doped with Mg and Zn. (See col. 23, lines 34-40 and Fig. 10 of Udagawa). The p-type stop surface layer 112 is thus made of a first nitride compound semiconductor material, and the p-type layer 103 is made of a second nitride compound semiconductor material. Furthermore, the p-type layer 103 of Mg-doped $\text{Al}_{0.10}\text{Ga}_{0.90}\text{N}$ has a larger electronic band gap than the p-type top surface layer 112 of GaN doped with Mg and Zn.

Even assuming, *arguendo*, that the p-type top surface layer 112 is a current expansion layer (which Applicants do not concede), Udagawa does not teach or suggest that at least one layer made of a second nitride compound semiconductor material having a larger electronic band gap than a first nitride compound semiconductor material of the p-type top surface layer 112 is embedded therein. The limitation “embedded in the current expansion layer” in Applicants’ claim 1 necessarily requires that the embedded layer is enclosed or sandwiched by the current expansion layer. In contrast, as shown in Fig. 14 of Udagawa, the p-type top surface layer 112 made of a first nitride compound semiconductor material is arranged on only one side of the p-type layer 103 made of a second nitride compound semiconductor material. The p-type layer 103 is therefore not embedded in the p-type top surface layer 112. Udagawa therefore fails to teach or suggest “wherein at least one layer made of a second nitride compound semiconductor material having a larger electronic band gap than the first nitride compound semiconductor material is embedded in the current expansion layer to form a two-dimensional electron gas or hole gas in the current expansion layer”, as expressly recited by Applicants’ amended claim 1.

The other cited references, Nozaki and Schubert, were cited by the Examiner as purportedly disclosing the features of dependent claims. However, nothing has been found in Nozaki and Schubert that would remedy the deficiencies of Udagawa with respect to the features of claim 1 discussed above.

Independent claim 1 is therefore deemed to be patentably distinct over the applied art.

Claims 3-22, which each depend from independent claim 1, distinguish the invention over the applied prior art for reasons discussed above in regard to the independent claims as well as on their own merits.

New claim 22 recites “wherein the current expansion layer includes two partial layers made of the first nitride compound semiconductor material separated from one another by the at least one layer made of the second nitride compound semiconductor material.” Support for this claim is found at least in paragraph 48 of the published application.

CONCLUSION

This application is now believed to be in condition for allowance, and early notice to that effect is solicited.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
COHEN PONTANI LIEBERMAN & PAVANE LLP

By /Alfred W. Froebrich/
Alfred W. Froebrich
Reg. No. 38,887
551 Fifth Avenue, Suite 1210
New York, New York 10176
(212) 687-2770

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